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Research Summary

Developing Implementation Strategies for Risk Based Inspection (RBI)

Results from five decades of bridge inspections have shown that most bridges deteriorate at a relatively slow rate, typically maintaining the same condition rating for 10 years or more when the bridge is maintained. Design features, materials, and corrosion protection strategies have evolved to minimize deterioration and ensure a long service life of modern bridges. Recent changes to the National Bridge Inspection Standards (NBIS) allow for extended inspection intervals of up to 72 months based on risk analysis. Known as Risk-Based Inspection (RBI), this approach to inspection planning has been implemented in many industries to improve the efficiency of inspections and focus inspections on higher-risk components.

The primary objective of RBI is to focus inspection resources on bridges where inspection needs are greatest. RBI practices analyze the probability of a bridge deteriorating to a serious condition and assesses the outcome or consequence that would result if the deterioration occurred. The probability of damage and the resulting consequences are used to estimate the risk.

Risk = Probability x Consequence

The goal of this project was to improve asset management through the implementation of RBI practices. The research was intended to amplify the results of the National Cooperative Highway Research Program research that produced a guideline and framework for RBI adopted by the NBIS. The research focused on developing implementation strategies to aid bridge owner's implementation of these new NBIS rules.

"... this approach to inspection planning has been implemented in many industries to improve the efficiency of inspections and focus inspections on higher-risk components."

Experts from six states identified the bridge attributes from their state's bridge inventory which affect the probability of deterioration and damage. Criteria for ranking the attributes within a simple quantitative scoring methodology and analyzing consequences were developed. The attributes, criteria, and consequence analysis formed a risk model for assessing the risk and determining an appropriate inspection interval for bridges based on their condition and durability characteristics.

The research studied the historic deterioration patterns of bridges in participating states to assess the service life of bridges in different operational environments. The risk models developed by expert panels were studied. The risk models were applied to a population of 60

randomly selected bridges to analyze their effectiveness for identifying inspection needs for bridges. A new methodology for analyzing the risk models developed by the expert panels was developed during the research. This data-driven approach analyzes risk models based on existing bridge inventory data and Monte Carlo simulations. Monte Carlo simulation uses probabilistic theories to study potential outcomes from applying the risk models to a bridge inventory. This method provides an effective means of calibrating the risk models to meet requirements.

This research found the risk models developed by experts to be consistent. The consistency of the RAP outcomes with the target ranges was a significant finding. It was also found that the risk models developed by the expert panels were consistent NBIS requirements when applied to the sample population of bridges. Results showed that more than 50% of the sample bridges in good condition could be placed on a 72-month inspection interval. The Monte Carlo methodology developed provided an effective tool for analyzing the risk models, calibrating the risk models to meet target ranges based on NBIS requirements, and demonstrating the effectiveness of the models.

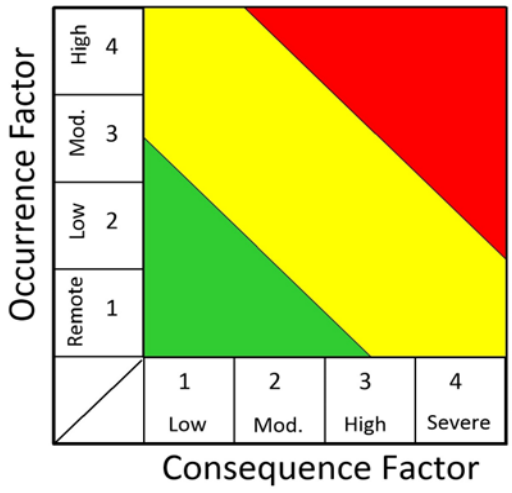

Figure 1: Risk matrix for Risk-based Bridge Inspection.

Project Information

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